WATERWAY FROM ROTTERDAM TO THE SEA.

1914

WATERWAY FROM

ROTTERDAM TO THE SEA.

Printed by P. W. M. Trap. Leiden.

WATERWAY FROM -:- ROTTERDAM TO THE SEA.

CONTENTS.

		Page.
I.	Historical Review up to the Middle of the 19th Century	1
II.	The Construction of the New Waterway	13
III.	Report of the Royal Commission of 1877	23
IV.	Improvements from 1881 to 1896	28
V.	Improvements from 1897 to 1907	39
VI.	Improvements in accordance with the Act of 1908	45
VII.	State of the Waterway in 1914	54
VIII.	The Signification of the Waterway for Commerce and Shipping	59
IX.	Conclusion.	73

LIST OF ILLUSTRATIONS.

		Page.
1.	Lightship "Maas".	1
2.	Steam Pilot Cutter	2
3.	Whistling Light Buoy	3
4.	North Pier with Lighthouse	4
5.	Prolongation of the South Pier in Construction	5
6.	Semaphore at Hook of Holland	7
7.	Signal Station at Hook of Holland	8
8.	Self-Loading Suction Dredger.	9
9.	Reporting Office at Hook of Holland	10
10.	Dock for Government Vessels at Hook of Holland	11
11.	Night Reporting Office at Hook of Holland	12
12.	Harwich Hook of Holland Quay at Hook of Holland	14
13.	Twin Screw Steamer "Rotterdam"	15
14.	Wm. H. Müller and Co.'s Branch, Hook of Holland	17
15.	"Vianda" Company's Cold Stores	18
16.	Mooring Post with Intermittent Light in the Waterway	19
17.	Hudig and Pieter's Export Slaughter House	21
18.	Poortershaven.	22
19.	Maassluis Harbour	24
20.	Dutch Asphalt Works Ltd. Maassluis	27
21.	Barge Unloading Suction dredger in Action	29
22.	"Matex" Co.'s Tank Installation	31
23.	Coal Trading Association Bunkering a Liner.	32
24.	Tugboat "Roode Zee"	33
25	Superphosphate Works "Holland"	34
26.	Chemical Installation at Vondelingenplaat	37
27.	Twin Screw Mailsteamer "Insulinde".	38

Page.

28. Salmon Fishery "Oranje Nassau" 40
29. Ice-breaker "P. Caland" 41
30. Yard "Gusto" at Schiedam 42
31. Rotterdam Dockyard Company 44
32. Wilton's Engineering and Slipway Cy. 46
33. Wilton's Floating Docks 49
34. Wilton's Floating Crane "Titan" 50
35. Rotterdam Lloyd Co.'s Quays and Sheds . . . . . } 52/53
36. Cargo Boat Harwich—Rotterdam at Parkkade . . . . . }
37. Tank Installation at Rotterdam 55
38. Benzine Installation of the Royal Dutch Petroleum Company . . 58
39. Wharf of Messrs Pakhuismeesteren at Rotterdam 61
40. View of the Koningshaven at Rotterdam. 63
41. Office and Landing Stage of the Netherlands Steamboat Company . 66
42. "Fyenoord" Shipbuilding and Engineering Company. . . . } 68/69
43. W. van der Lugt and Sons' Manufactory of Wooden Packing Articles, Rotterdam . . . . . }
44. Messrs P. Smit Jr.'s Shipbuilding Yard 74

Digitized by the Internet Archive
in 2017 with funding from
This project is made possible by a grant from the Institute of Museum and Library Services as administered by the Pennsylvania Department of Education through the Office of Commonwealth Libraries

https://archive.org/details/waterwayfromrott00degr

LIGHTSHIP "MAAS", 13.5 KILOMETRES FROM THE ENTRANCE OF THE WATERWAY.

I.

HISTORICAL REVIEW UP TO THE MIDDLE OF THE 19TH CENTURY.

At the beginning of the Christian era a large bay, called by the Romans "Hellenium", penetrated deep inland at the spot now occupied by the Waterway from Rotterdam to the Sea. This bay extended as far as the present Eastern point of the island of Rozenburg, was about three miles broad, and formed one of the three principal estuaries of the Rhine into which a great part of the water of the Maas was also discharged.

In later years this broad part including the present Oude Maas was called "Die Maeze", whilst that between

Vlaardingen and Dordrecht was known as "Die Merwe".

It is obvious that sooner or later towns and villages would arise along the coasts of this bay and the banks of the rivers which flowed into it.

Vlaardingen, the oldest of the towns in South Holland was already in existence when, in the year 1015, Dordrecht was founded on the most favourable spot for the collection of tolls from the vessels navigating the Rhine. In the 13th century Schiedam and

STEAM PILOT CUTTER, CRUISING BEFORE THE ENTRANCE OF THE WATERWAY.

Rotterdam arose where dams had been built in the Schie and the Rotte. Maassluis was founded later on the right bank of the "Maeze", whilst on the opposite side stood the old town of Brielle.

These towns continued to flourish and extend owing in the first place to their favourable situation for the fishing industry and later in consequence of the in-

creasing trade to the Baltic, the Black Sea, England and Portugal. Rotterdam especially benefited by its favourable situation, so that at the end of the 14th century it had already outgrown the neighbouring towns.

A favourable state of things continued, until the 15th century saw a great change in the state of the dykes, canals, rivers, etc. of the country.

WHISTLING LIGHT BUOY BEFORE THE ENTRANCE OF THE WATERWAY.

On the 18th of November, 1421, a terrible storm raged on the Dutch coast, and the accompanying high tide the "St. Elizabeth Flood", inundated very many of the polder lands.

The civil wars in Holland and Zeeland coöperated in preventing any vigorous efforts being made to

ENTRANCE OF THE WATERWAY; NORTH PIER WITH LIGHTHOUSE

PROLONGATION OF THE SOUTH PIER (GUIDING DAM) IN CONSTUCTION. JULY 1914.

regain, by the construction of dykes, the territories which had been lost.

The disaster of 1421 had yet another far-reaching consequence, namely, a radical alteration in the course of the lower rivers. The whole of the water of the Waal and a great part of that of the Maas which had originally flowed past Vlaardingen found egress to the sea by more southerly outlets, so that after 1421 only the water of the Lek, forming but a fourth part of the former volume, flowed through the river known later as the Nieuwe Maas.

Owing to the diminished flow of water the mouth of the river began to fill with sand in such a manner that the construction of dykes around the shallow places was rendered possible. The island of Ysselmonde was enlarged, and to the west of this island shoals began to form, in consequence of which the stream, at one time so broad, was divided into two channels.

Still later these shoals were dyked in, so that two islands arose, which, in 1634, were joined together, thus forming the present island of Rozenburg. The large bay between Maassluis and Brielle was thereby reduced to two relatively narrow streams, of which the Northerly one was hardly a quarter as wide as the original bay, and in which, later, shoals gradually began to form.

The constantly increasing navigation from Rotterdam had to find its way to the sea along the Brielsche Maas, but the sandy bottom of the Brielsche Zeegat was so changeable that in 1616 the States of Holland instructed the pilots to take soundings of the fairway

SEMAPHORE AT HOOK OF HOLLAND, SHOWING DEPTH OF WATER IN THE ENTRANCE OF THE WATERWAY.

after every storm. A depth of 10 feet, which for those times was adequate could generally be relied upon.

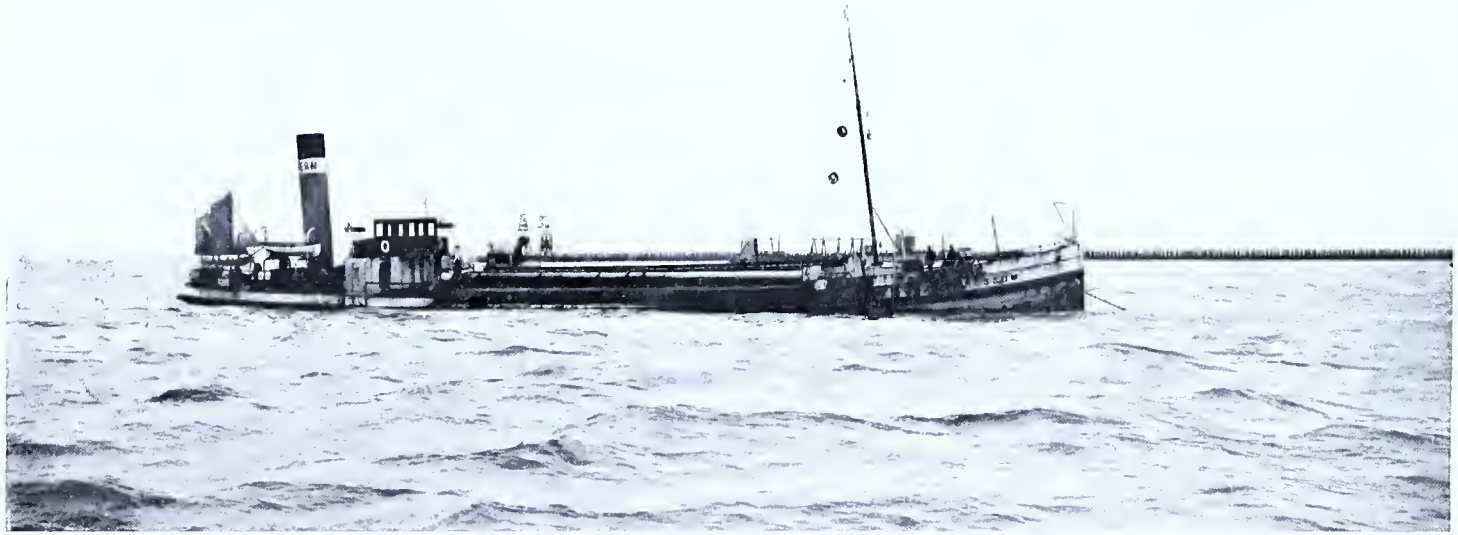
Owing to the increasing shallowness of the Brielsche Zeegat ships were under the necessity of sailing out to sea via the Goereesche Zeegat, following the Nieuwe Maas from Rotterdam as far as Vlaardingen and then proceeding via Botlek, Oude Maas, Dordtsche

L. SMIT & Co's SLEEPDIENST, ROTTERDAM.
TUG AND SALVAGE COMPANY.

SIGNAL STATION AT HOOK OF HOLLAND.

Kil, Hollandsch Diep and Haringvliet. Although this outlet was of sufficient depth for that period, i. e., 5 metres at low water, many complaints were made on account of its length and the numerous shoals met with along its course.

Numbers of plans for improvement were drawn



SELF-LOADING SUCTION DREDGER IN THE ENTRANCE OF THE WATERWAY.

up, amongst them being one by Nicolaas Cruquius for cutting through the Hook of Holland. With the exception, however, of a small improvement of the fairway carried out between 1789 and 1800, nothing was done.

DIRKZWAGER'S SHIP AGENCY, MAASSLUIS

REPORTING OFFICE AND LLOYDS SIGNAL STATION AT HOOK OF HOLLAND.

Nor was the succeeding French period convenient for carrying out such works, as commerce and shipping were almost at a standstill.

With the restoration of the Independence of the Netherlands, and the revival of trade, people's thoughts turned again to the matter of effecting improvements in the interests of shipping. In order to connect the

DOCK FOR GOVERNMENT VESSELS AT HOOK OF HOLLAND.

DIRKZWAGER'S SHIP AGENCY, MAASSLUIS.

NIGHT REPORTING OFFICE AT HOOK OF HOLLAND.

Government Shipbuilding Yard at Rotterdam with Hellevoetsluis, where the vessels were equipped — in the interest therefore of national defence — a proposition was made to cut a canal through the island of Voorne, and the work was carried out between 1827 and 1829.

On the completion of this canal vessels with a full cargo were able to get to the sea from Rotterdam in about 7 hours.

The canal is more than 10 kilometres long, $5^1/_2$ metres deep, 10 metres wide at the bottom, and 37 at the surface. Locks are placed at both ends.

These dimensions were sufficient for the mercantile fleet of those days, but very soon complaints arose regarding the constant forming of shoals in the Goereesche Zeegat, and many vessels were compelled to proceed to sea through the Brouwershavensche Gat.

The plans for the construction of the Suez Canal and the establishment of regular lines of steamers to North America rendered it essential for Rotterdam to have a shorter way to the sea, and very soon demands were heard for radical improvements.

II.

THE CONSTRUCTION OF THE NEW WATERWAY.

The towns of Brielle and Rotterdam having petitioned the authorities to institute an inquiry as to the possibility of so improving the mouth of the

GREAT EASTERN RAILWAY COMPANY. HARWICH—HOOK OF HOLLAND SERVICE.
AGENTS: HUDIG AND PIETERS.

PASSENGER STEAMER AND CARGOBOAT AT THE QUAY OF THE HOLLAND RAILWAY COMPANY AT HOOK OF HOLLAND.

TWIN SCREW STEAMER "ROTTERDAM" 24170 TONS REGISTER, 37190 TONS DISPLACEMENT.

Nieuwe Maas, that the necessity for a canal through the island of Flakkee — a subject much discussed in those days — would be obviated, the Government instructed the Waterstaat Engineer P. Caland to ascertain what had been done under similar conditions in Scotland and France and to decide to what extent the works carried out there might be imitated for the improvement of the Brielsche Zeegat.

At the conclusion of his journey, Mr. Caland, on the 25th of January 1858, presented a complete plan for the construction of an open waterway through the Hook of Holland, which the Council of Waterstaat (a committee appointed by the Minister) on the 21st of August 1858, very strongly recommended the Government to put into execution.

According to this plan the Scheur along the north side of the island of Rozenburg was to be followed and not the river along the south side of that island, and a cutting made through the Hook of Holland to provide an outlet to the sea north of the Brielsche Zeegat. This new river mouth was to be carried out into the sea by two piers of brushwood and stone, the lower mouth of the Scheur was to be closed by a dam, and the new river mouth would be formed by tidal action, i.e., by Nature. Mr. P. Caland the engineer was of the opinion that if a channel, 50 metres wide and 3 metres deep at low water, were cut through the dunes, the current — aided by a single dredger — would do the rest.

This work (estimated to cost fl. 6.300.000), was to be completed in five years.

VIEW OF HOOK OF HOLLAND BRANCH WITH DISCHARGING AND LOADING BERTHS FOR SEAGOING STEAMER.

"VIANDA" COMPANY HOOK OF HOLLAND

COLD STORES WITH RAILWAY SIDING. DISCHARGING BERTH FOR SEAGOING STEAMERS.

The Act of January 24th, 1863, (Official Gazette N°. 4) in which in the first place the construction of the canal from Amsterdam to the North Sea was ordered, provided in the second place for the *improvement of the Waterway through Rotterdam to the sea*, in accordance with Engineer Caland's plan, on the following general principles, viz:

The river at Krimpen to be widened to 225 metres, and further down to 450 metres at Vlaardingen,

MOORING POST WITH INTERMITTENT LIGHT IN THE WATERWAY.

530 metres at Maassluis and to 900 metres in the mouth at the Hook of Holland, with an adequate depth; this entrance to be formed by dykes in connection with two piers or moles to be carried out to the sea to a sufficient depth.

A start was made in August 1863. H. R. H. the Prince of Orange turned the first sod on the 31st of

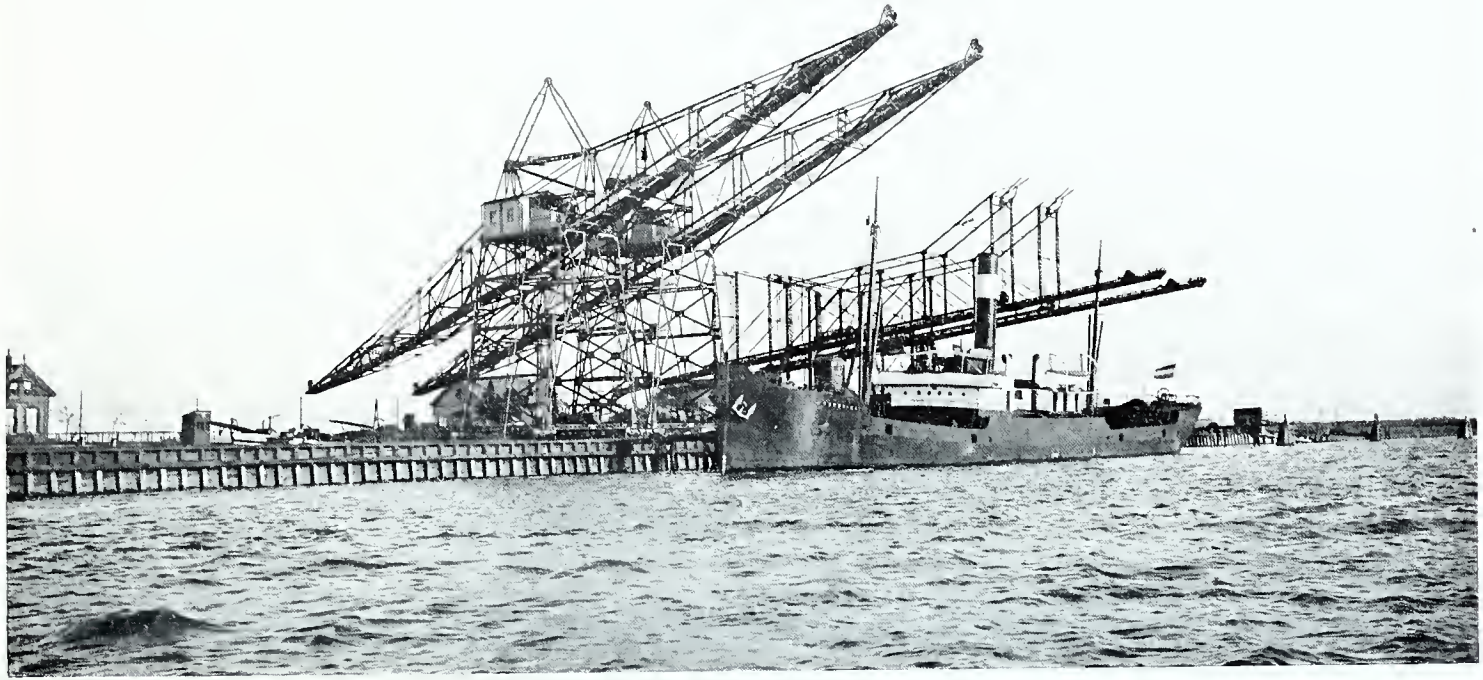
October 1866, at the Hook of Holland. The following memorial was drawn up:

"To-day at noon H. R. H. the Prince of Orange "turned the first sod at the Hook of Holland for the "improvement of the Waterway from Rotterdam to "the sea", and was signed by the following persons:

Prince of Orange.	Van Vollenhoven.
Heemskerk.	Van den Bergh van Heemstede.
Van Zuijlen van Nievelt.	Rengers van Warmenhuizen.
R. Schimmelpenninck.	Conrad.
Pels Rijcken.	P. Caland.
J. Loudon.	J. F. Boogaard.
Mackay van Ophemert.	Van der Linden.

On the 26th of November, 1868, connection with the sea was accomplished. In September 1870 the first two boats — fishing vessels — sailed through the opening and were followed on July 10th 1871, by the first fishing-smacks, whilst the S. S. "Richard Young", of the Rotterdam Harwich Line, with a draft of 30 decimetres was the first steamer to navigate the New Waterway on the 9th of March, 1872; the buoys were anchored on the 19th March 1872.

SLAUGHTER HOUSE FOR EXPORT AT HOOK OF HOLLAND.



PRIVATE DOCK FOR DISCHARGING, LOADING AND WAREHOUSING OF GOODS.

III.

REPORT OF THE ROYAL COMMISSION OF 1877.

The state of things which had originally seemed so promising, became after the opening not better but worse, especially at the mouth, so that the conviction was gradually formed that, although the principle of deepening by the force of both ebb and flood tide had proved to be correct, it would be impossible to continue on the same lines, if no difference were made between the river and the entrance.

In order to enable Parliament to form a correct opinion regarding further improvement before consenting to further expenditure, a Royal Commission was appointed. (Royal Decree, December 4th 1877, No. 1).

In 1878 this Royal Commission issued an interim, and in 1880 a final report. In these reports the principles of the original plan of 1863 were fully maintained, viz: *an open river* of adequate depth and so constructed that the tide could rush in, and during ebb tide, strengthened by the water from the upper courses of the river, could form and maintain the depth.

Although the opinion at that time was that too great an importance had been attached to the formation of the Waterway by the tidal currents, yet it

MAASSLUIS HARBOUR. OFFICE AND LLOYD'S SIGNAL STATION AT MAASSLUIS.

was thought that the afore mentioned plan should not be deviated from, but that the system of forming the fairway by ebb and flood *alone* should be discarded. The opinion of the Royal Commission was, that in the application of this principle lay the chief cause of the disappointment experienced.

The large masses of sand which had settled in the mouth, instead of being carried away by the current were the cause of a large disproportion arising between the profiles of the channel at the Cutting and at the mouth. In consequence of the considerable narrowing of the channel in the mouth, the water from the upper rivers could not find egress to the sea at ebb tide at a sufficient rate, the consequence being that too large volumes of water were diverted into the Botlek and the Brielsche Maas.

Furthermore, the great width of the mouth and the insufficient wearing away of the channel were factors rendering impossible the application of the principal conditions essential for maintaining the depth of a tidal river, namely: uniform and rapid transmission of the tidal-wave, regular and rapid entrance of the flood and outflow of the ebb in the same channel, and in a regular continuous direction.

To secure adequate improvement the Royal Commission deemed it necessary to definitely discard the system of deepening by the force of the current, and the following works were considered necessary, viz:

Correction of the river from Krimpen to the entrance to the sea, closing of the Botlek, restriction of the width of the mouth and the construc-

tion of a canal with a lock through the eastern end of Rozenburg;

Artificial forming of the corrected river by dredging up to the mouth and between the piers in the sea;

Raising of the piers above the height of the springtide in order to stop the overflow of water under ordinary circumstances, and to cause all the ebb and flood water to stream into and out of the mouth for the maintenance of the required depth;

Lengthening of the piers into the Sea to the natural depth of 9 metres at low water.

The Royal Commission therefore proposed to create a continuous river of an average depth of 3.50 metres at low water, with a fairway at least 100 metres wide and at least 6.50 metres deep at low water.

Only between the piers was the channel to be more deeply dredged, viz: from 7 to 8 metres at low water over a breadth of 200 metres. To achieve this, some 3.000.000 cubic metres of earth between Krimpen and Rotterdam would have to be dredged, 5.000.000 cubic metres between Rotterdam and the east point of Rozenburg, 22.000.000 cubic metres between this point and the land-end of the piers; 3.000.000 cubic metres between and in front of the piers; total, about 33.000.000 cub. metres.

In the event of the execution of those plans a favourable result and the achievement of the object in view was anticipated, i.e., the obtaining of a water-

MANUFACTORY OF ASPHALT POWDER, PAVING SLABS AND MASTIC CAKES AT MAASSLUIS.

way along which ships with a draught of 7.50 metres could reach Rotterdam.

The upper river would not cease to bring sand down, though this would be quite different from the influx of sand as a result of the wearing away of the lower river.

The latter influx was not anticipated subsequent to the correction of the rivier; hence the forming of banks in and around the mouth was considered to be no longer possible. Dredging of the sand brought down by the upper river would be required and regarded as a part of the annual work of maintenance. The total cost of all the necessary works was estimated at fl. 30.000.000 of which fl. 13.000.000 was for dredging alone; eight years was the time specified for the work.

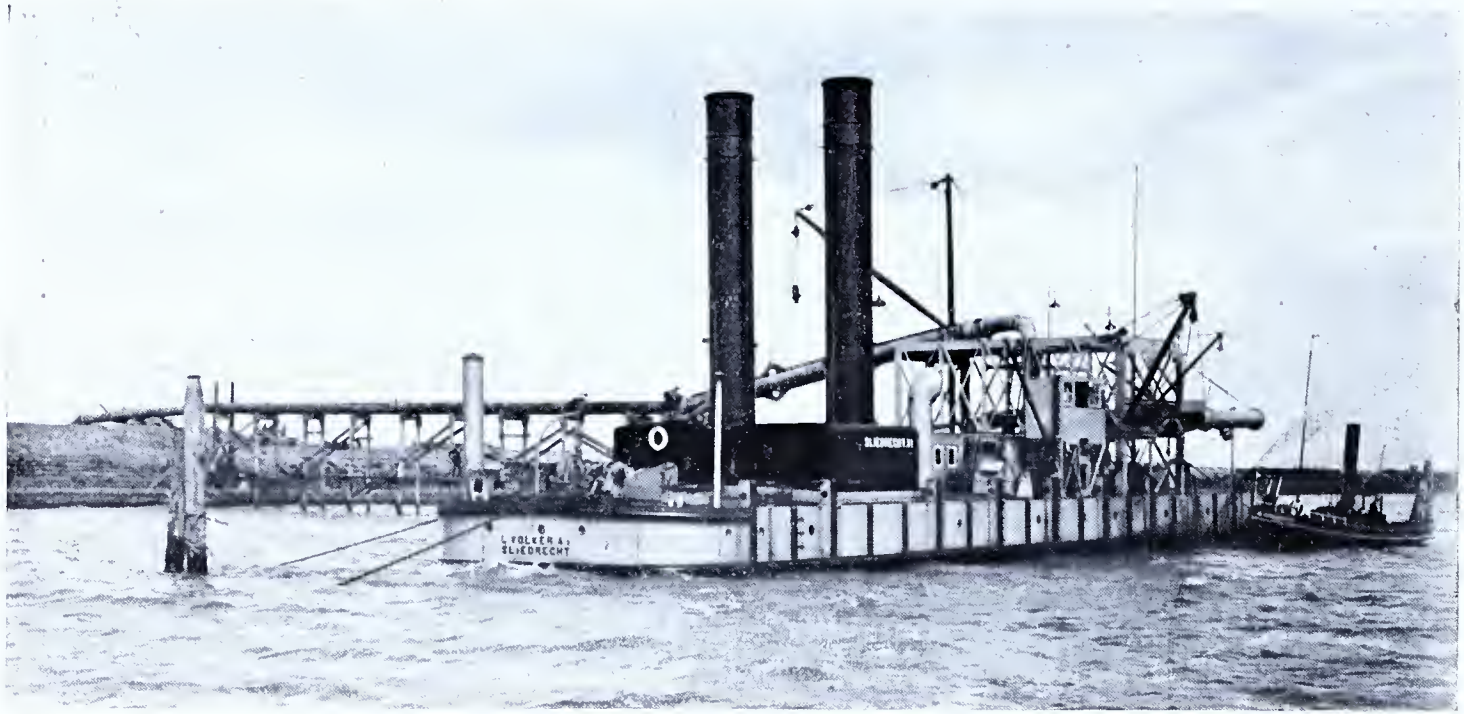
The yearly cost of upkeep was estimated at fl. 235.000, of which fl. 130.000 would be expended in dredging the river bed.

IV.

IMPROVEMENTS FROM 1881 TO 1896.

In 1881 a Bill was introduced into Parliament authorising alteration of the dimensions determined upon in 1863, the provisions of which were quite in accordance with the spirit of the reports submitted.

In the course of the extented debates on the subject, a keen fight took place — as was the case twenty



BARGE UNLOADING SUCTION DREDGER IN ACTION.

years before — between the advocates for, and the opponents of, an "open" waterway. And again many other plans were suggested, but the Government kept to the principle adopted, viz, *an open channel to the sea.*

Notwithstanding the many warning voices heard from various sides it was decided by the Act of 26th July 1881, (Official Gazette No. 140) to keep to the principle of an open channel in accordance with the decision taken in 1863.

That this has been of enormous importance for the extension of the trade of Rotterdam is amply proved by an examination of the yearly statistics regarding the movement of shipping.

It goes without saying that the maintaining of the principle of an open channel has, from an economical point of view, far-reaching consequences, when the possibility of gradually increasing the depth of the fairway without incurring too great an expenditure is pointed out; whilst if the river were to be artificially closed off, any increase in its capacity would on each occasion entail the construction of locks of large dimensions which would not only take a long time to build but would cost large sums of money.

The normal breadth of the projected waterway was decided upon as follows: 250 metres at Krimpen, from there gradually widening to 340 metres at Rotterdam, 450 metres at Vlaardingen, 530 metres at Maassluis; 630 at the beginning of the Cutting through the Hook of Holland, and 660 at the land end, 685 at the extremity of the existing North pier; and

TANK INSTALLATION "MATEX"

COAL TRADING ASSOCIATION. (STEENKOLEN-HANDELSVEREENIGING).

BUNKERING A LINER BY MEANS OF SELF REGISTERING AUTOMATIC WEIGHING, COALING PLANT FROM BOTH SIDES SIMULTANEOUSLY.

700 metres where the waterway will finally enter the sea after the proposed lengthening of both piers.

The execution of these works was at once taken energetically in hand. They were carried out between

L. SMIT EN Co's SLEEPDIENST, ROTTERDAM.
TUG AND SALVAGE COMPANY.

TUGBOAT "ROODE ZEE" 171′ × 30′ × 18′. 1500 I. H. P.

1881 and 1896, and consisted of the dredging of the shoals at the mouth of the river; in the construction of a low pier parallel with the South Pier; in the enlarging of the Cutting at the Hook of Hol-

SUPERPHOSPHATE WORKS "HOLLAND". PERNIS NEAR ROTTERDAM

CAPACITY 60000 TONS PER ANNUM.

land; in the narrowing of the Noordgeul, being the confluence of the rivers near the Eastern end of Rozenburg; the enlarging and correcting of the Scheur and the Nieuwe Maas; the construction of works for the protection of the banks against erosion; whilst in addition a canal with the requisite locks was cut through the western point of Rozenburg in order to enable a part of the dredgings to be dumped into the Maasvlakte opposite Brielle.

From 1881 up to and including 1896, the sum of fl. 20.800.000 was expended of which 10% was contributed by the municipality of Rotterdam. In this expenditure is included the amount required for the improvement of the river — 11 kilometres in length — between Krimpen and Rotterdam. The total sum expended since the inception of the work amounts to fl. 36.300.000.

Along both banks of the river between Krimpen and the sea dams have been constructed to a total length of 10.7 kilometres, with 1.8 kilometres of connecting dam, 21.5 kilometres of bank defence work, 1.6 kilometres of cross jetty and 2.2 kilometres of *submerged dams*. The North Pier at Hook of Holland is 2 kilometres in length, the South Pier 2.3 kilometres. The mole between those piers and running parallel with them is 1.6 kilometres and the connecting dams from the mole to the South Pier are together, 0.7 kilometres long. The dunes along the Cutting at the Hook of Holland are protected by a covering of stones 4 hectares in area. The dam through the Scheur is 860 metres in length. The above mentioned

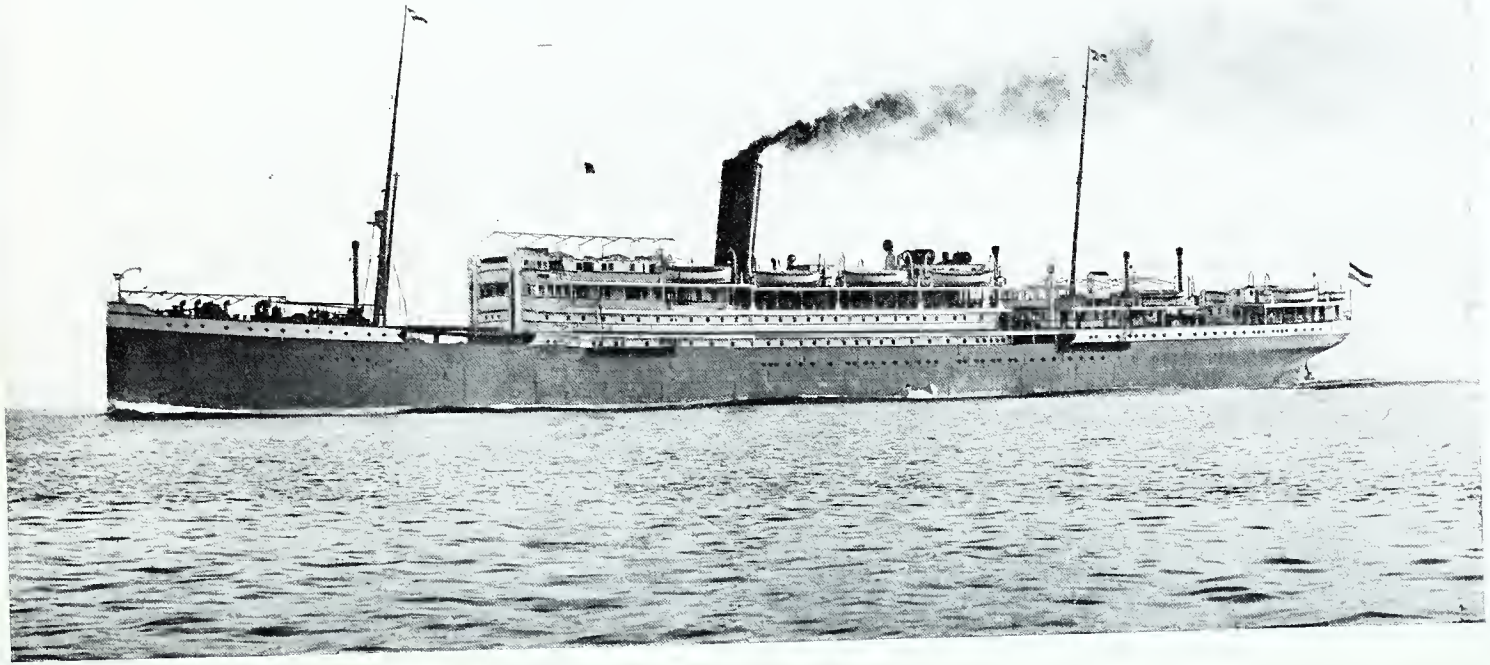
canal through Rozenburg is 1.93 kilometres in length. Altogether up to 1880 some 14.000.000 cubic metres of earth were removed between Krimpen and the Sea, and another 42.000.000 cubic metres from 1881 up to and including 1896 or a total of 56.000.000 cubic metres.

The self-loading suction dredgers — invented by Dutch contractors and built in Dutch shipbuilding yards — which were employed from 1878 at the Hook of Holland, rendered excellent service, and being very seaworthy enabled dredging to be carried on even with a ground swell of nine decimetres.

One or two of the subdivisions of the plan drawn up by the Royal Commission were not put into execution however. For example, the plan for the damming of the Botlek was not carried out, but the confluence of the rivers at the eastern point of Rozenburg (Noordgeul) was considerably reduced in width. The proposed extension of the piers was not carried out, as the results obtained with the length at that time were quite satisfactory.

INSTALLATION AT VONDELINGENPLAAT.

ROTTERDAM LLOYD. ROTTERDAM.



TWIN SCREW MAILSTEAMER "INSULINDE".
Carrying capacity 9808 tons Displacement 16508 tons.

V.

IMPROVEMENTS FROM 1897 TO 1907.

Although the depth of the Waterway in 1896 was in accordance with the act of 1863, the rapid increase of navigation and the greater size of ships necessitated new measures being taken. The number of ships with a draft of 70 decimetres and over, passing through the New Waterway, had increased to 278 in 1897.

In the first place, extensive dredging operations for the deepening and widening of the fairway were carried out.

In places where by dredging no permanent depth could be secured, the width of the fairway was restricted. The limitation of that width by means of submerged dams, commenced in 1892, has led to the required depth being secured. These dams originally reached a height of 5 metres below the surface at low water at the river end, from where they gradually rose to a height of 3 metres at low water at the land end. In 1897 they were made one metre higher in order to concentrate the current in the fairway.

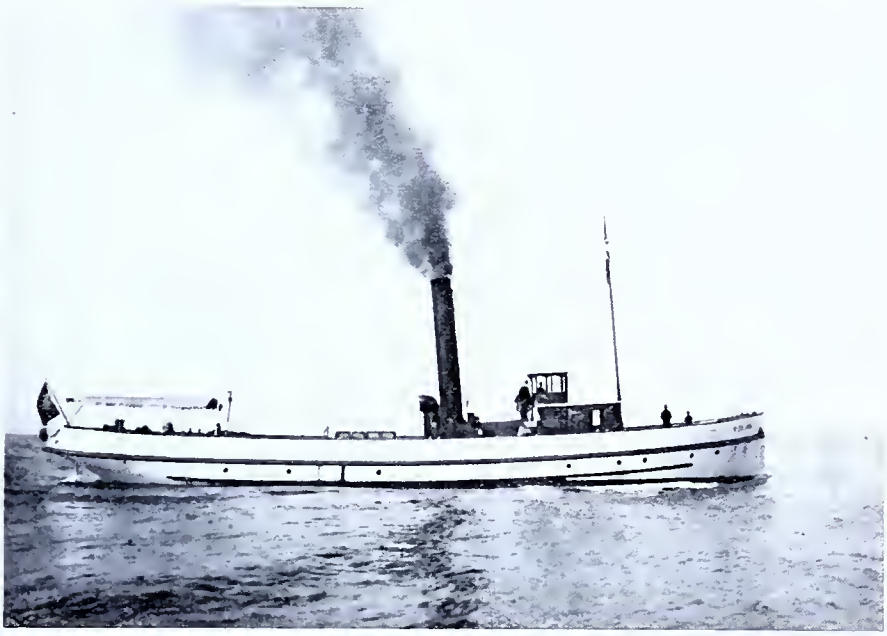
The fairway between the heads of the submerged dams is 280 metres in breadth and is intended for ocean going vessels, whilst inland vessels of small draft can safely pass over them.

In consequence of this narrowing it was found possible to maintain the fairway at a greater depth.

SALMON FISHERY „ORANJE NASSAU" BETWEEN SCHIEDAM AND VLAARDINGEN.

This system had still other advantages. First it was possible to higher the dams by means of the sand dredged from the fairway and the remaining dredgings could be discharged between the dams, thus saving heavy transport expenses.

Secondly, subsequent to the completion of the dams,



ICE-BREAKER, AT THE SAME TIME STEAMER OF THE DIRECTION OF THE WATERWAY.

it could be observed whether or not they had any influence on the direction of the current and upon the depth, whilst any eventual alteration in the course of the fairway could be carried out with more facility and at less expense than would have been possible by the employment of longitudinal dams. The construction of submerged dams, carried out simultaneously with dredging operations in the river and

MESSRs. A. F. SMULDERS YARD "GUSTO" AT SCHIEDAM.

SHIPBUILDING YARD AND ENGINEERING WORKS.
DREDGING PLANT, FLOATING CRANES, COALING VESSELS. TUGS. EXCAVATORS, ETC.

the mouth, necessitated an expenditure of about fl. 1.800.000 between 1897 and 1907. For this comparatively small sum a continuous fairway of a minimum depth of 7½ metres at low water or 9 metres at high water was secured.

This system has proved that by working further on the same lines a still greater depth may be secured at a relatively low cost. This greater depth was met with in various places along the Waterway at the end of the decade mentioned, but the size of ships using the Waterway was dominated by one particular place, viz. at Maassluis where the direction of the current changes and where a very troublesome obstacle was always present, as from the time the work was commenced shoals continually formed there and had to be repeatedly dredged away.

Nevertheless in 1906, 51 vessels drawing 80 decimetres and over, amongst them being 14 drawing 85 to 89 decimetres, navigated the Waterway.

Whilst it appears from the facts cited that the work has proved successful beyond expectation, it must also be recognised that commerce has benefited in a high degree thereby, partly also owing to the liberality and foresight of the Corporation of Rotterdam which has met the requirements of trade and shipping by incessant improvement and extension of the port, as witness the splendidly equipped docks, of which the Waalhaven with a superficial area of 300 hectares, is estimated to cost fl. 20.000.000.

ROTTERDAM DOCKYARD COMPANY. REPAIRERS, SHIPBUILDERS, ENGINEERS.

FIVE BUILDING BERTHS AND TWO FLOATING-DOCKS OF 8000 AND 3000 TONS LIFTING POWER.

VI.

IMPROVEMENTS IN ACCORDANCE WITH THE ACT OF 1908.

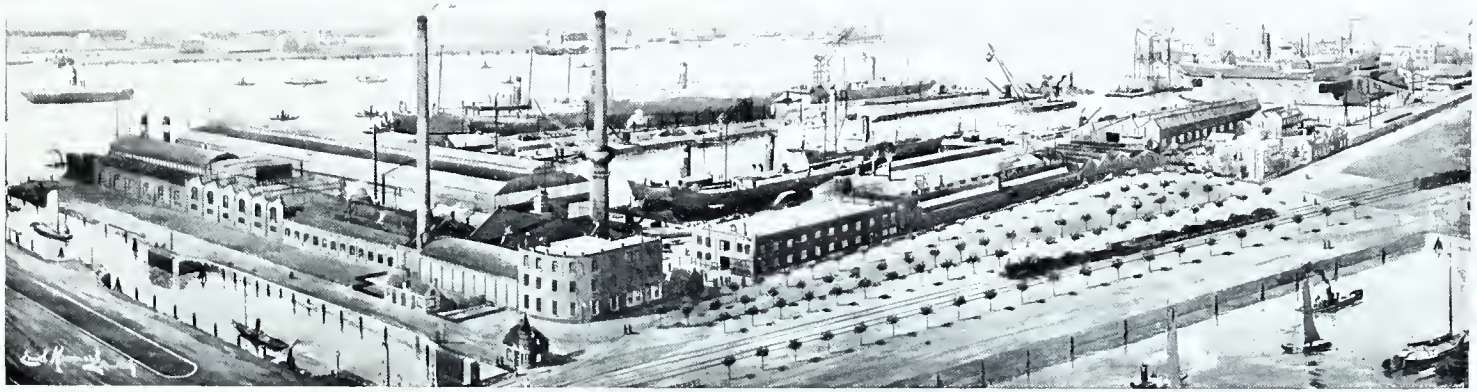
In 1903 the average dimensions of the twenty largest vessels then employed in the mercantile service were as follows: length, 195 metres; breadth, 21 metres; draft, 9.8 metres; capacity 17.000 register tons. The dimensions of the "Nieuw Amsterdam", the largest vessel then owned by the Holland America Line were: length, 189 metres; breadth 20.89 metres; draft 10.44 metres; capacity, 16.000 register tons. A still larger vessel was in course of construction for the Company.

It could not at that time be regarded as a requirement of commerce that ocean-going steamers of such dimensions should be able to reach Rotterdam loaded to their full capacity, but the interest of the port of Rotterdam demanded that in good time it should be made accessible for vessels of larger dimensions.

The shipping trade therefore claimed increased depth of the channel

It was believed possible to secure this in the first place by dredging those places where the required depth was wanting; but in the second place it was regarded as essential to strengthen the movement of the tide in order to ensure the maintenance of the increased depth. The water is arrested in its course by the South Pier and enters the Waterway after describing a wide curve, in consequence of which the

WILTON'S ENGINEERING AND SLIPWAY Co. ROTTERDAM.



WILTON'S YARD 1914. GENERAL VIEW

strongest current is met with in the northern half of the mouth — at least when the tide is beginning to rise — whilst but a weak current runs on the south side.

The required improvement in changing the direction of the tidal current at the mouth was planned to be effected by lengthening the South Pier by means of a guiding dam running in the direction of the current. By lengthening the South Pier the turning point of the current would be moved southwards and consequently the stream would enter the mouth of the Waterway more evenly and more to the south of the mouth. By vigourous dredging at the projecting point of the "*Zuidwal*" the flow of the water into the Waterway could also be facilitated.

The cost of the proposed works was estimated at fl. 4.000.000, half of which sum was to be expended in constructing the above mentioned guiding dam and in carrying out the dredging operations at the "Zuidwal".

By the Act of May 25th, 1908, (Official Gazette No. 137) the required funds were voted by which Rotterdam was ensured of a waterway with a continuous fairway at least 100 metres wide and with a depth of 8 metres at low water, or 9½ at high water.

With this depth vessels drawing 9 metres of water would under ordinary circumstances be able to reach Rotterdam, and vessels leaving the port and drawing a little less water could reach the sea during the same tide.

Immediately the bill was passed, large masses of earth were removed so that already in 1909 a fairway 8 metres in depth at low water and 10 at high

water had been secured from end to end of the Waterway. Submerged dams and longitudinal dams with a total length of 2½ kilometres were also constructed. At the moment forty four submerged dams of varying lengths are to be found on the right hand side and thirty six on the left between Maassluis and the North Sea.

From 1909 to 1913 7.500.000 cubic metres of earth were dredged in the river between Krimpen and the extremity of the Cutting at the Hook of Holland. In the quantity just mentioned is included that dredged for maintenance and that removed by other parties as well as 700.000 cubic metres in the course of deepening the Nieuwe Maas beyond Rotterdam. The latter work was carried out in 1910 and 1911 to strengthen the tidal movement in the Waterway.

Simultaneously with the dredging of the river a start was made with the construction of the foundation of the guiding dam along the whole projected length of 700 metres. It consists of fascines which as far as possible are covered with sand during the course of construction. The dam was at first built up to a height of 3½ metres below low water and was defended against erosion by a covering of stones. Altogether 180.000 square metres of mattress of brushwood and 90.000 tons of stone were employed in constructing the foundation (1 ton = 1000 kilograms). The expenditure incurred was about fl. 640.000.—

In the spring of 1911 the building of the superstructure was commenced. When a length of 120

WILTON'S FLOATING DOCKS OF 8500 AND 4500 TONS AND ONE DOCK IN CONSTRUCTION OF 15000 TONS LIFTING POWER.

metres had been completed a great storm destroyed it on September 30th, 1911.

In the following spring the completion of the guiding dam was once more taken in hand, but with some alteration in the profile by which the part built in 1908—1909 did service as berm.

WILTON'S ENGINEERING AND SLIPWAY Co. ROTTERDAM.

FLOATING CRANE "TITAN" WITH 120 TONS LIFTING POWER.

The superstructure of the dam for a length of 370 metres was completed in the autumn of 1914. 190.000 sq. metres of mattress, 145.000 tons of stone, and 8.400 wooden piles were employed in the construction of the superstructure.

Dredging of the "Zuidwal" was carried out on a large scale simultaneously with the execution of the

works just mentioned. In the period comprised between 1909 and 1913 2.000.000 cubic metres of dredgings were removed in and about the mouth of the Waterway, 2.500.000 between the piers, and more than 1.000.000 cubic metres in the Cutting at the Hook of Holland.

Here again, self-loading suction dredgers moving twelve to fifteen thousand cubic metres a week were employed. Whenever these dredgings could not be used for filling up the mattresses of the guiding dam, they had to be dumped into the sea at a distance of some five kilometres beyond the piers.

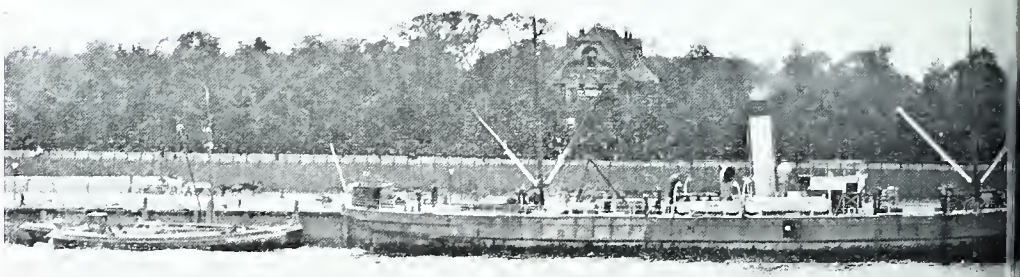
Nothing can yet be stated of the effect of the guiding dam, i.e. as to whether the formation of sandbanks in the river mouth has been reduced. But since the dam was constructed and the mouth of the river deepened, there seems to have been a change for the better in the direction of the current, and the ground swells which are a cause of fear and which formerly arose at the "Zuidwal" during stormy weather, have not been observed since, so that entering the river during a storm is attended with much less danger than was formerly the case.

The available four million guilders of which Rotterdam was to contribute a fifth part has now been expended.

The total cost of construction, improvement and upkeep of the Waterway between Krimpen and the sea amounted to fl. 51.500.000 up to 1913 inclusive. Some fl. 9.000.000, or an average of fl. 450.000 per annum for upkeep is included in that sum, of which fl. 200.000 per annum for dredging.

QUAYS AND SHEDS OF THE COM

GREAT EASTERN RAILWAY COMPANY. C



CARGO BOAT AT THE QU

ROTTERDAM.

STEAMERS. TRADING TO JAVA. 2

BOAT SERVICE HARWICH—ROTTERDAM.

ROTTERDAM, PARKKADE. 2

VII.

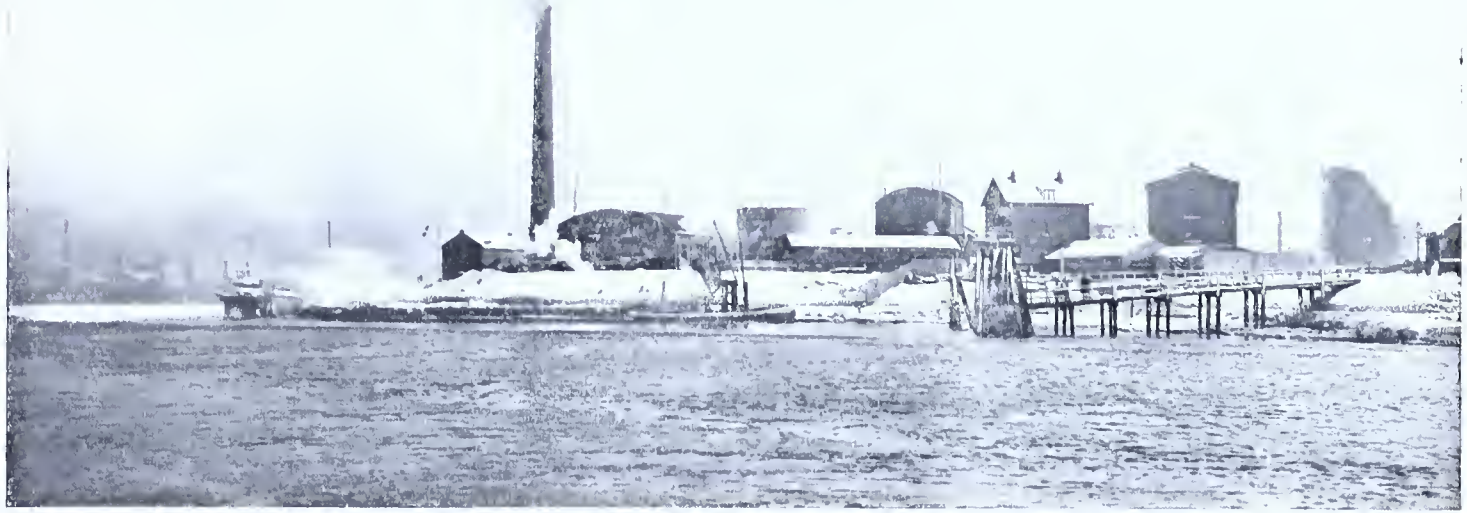
STATE OF THE WATERWAY IN 1914.

The state of the Waterway in 1914 may be regarded as satisfactory in every respect. The requirements of 1908 have been amply complied with and ships drawing 93 and 94 decimetres of water navigate the Waterway in both directions. The fairway of 8.50 metres in depth at low water dredged in 1909 still runs uninterruptedly from Rotterdam to the sea. The lowest depth sounded in the early part of this year was 83 decimetres at low water, which is equal to 99 decimetres at high water.

The fairway in the Cutting at the Hook of Holland has a minimum breadth of 200 metres which gradually increases to 270 metres at the mouth. The width of the fairway at a depth of 9 metres below low water is 255 metres in the mouth, and from there it runs uninterruptedly through to the Cutting.

There is now a fairway of 10 metres in depth at low water from the sea to about 600 metres between the piers, and at the narrowest point it is 115 metres broad.

The outlet at the Hook of Holland lies within the radius of light of two lighthouses, viz: the group flashlight of Goeree to the South and the group flashlight at Scheveningen to the North. Almost right in front of the mouth at a distance of 13.5 kilometres



TANK INSTALLATION AT ROTTERDAM.

from the piers, lies the lightship "Maas" anchored in about 23 metres of water and showing a revolving light. The whistling light-buoy at a distance of 1400 metres from the North Pier serves for further reconnoitring whilst the axis of the fairway in the mouth of the Waterway is indicated by two leading lights at the Hook of Holland. The extreme point of the North Pier is indicated by an iron beacon tower with a revolving light, and that of the South Pier by a permanent light.

A guide during foggy weather is the sirene and submarine signal of the lightship "Maas"; further guides are the whistling buoy at the entrance and two foghorns on the North Pier, of which one is kept for emergency.

Further inward up to the lower end of the Cutting the fairway is indicated by conical red buoys on the south side and flat-ended black buoys on the north side of the channel. From there as far as Vlaardingen lights placed on the banks provide guidance, but the lines of these leading lights do not always coincide with the axis of the changeable fairway. The true axis of the fairway is, however, indicated by large beacons on the banks of the river. These beacons consist of wooden poles from 9 to 19 metres in length to which are affixed a rectangular frame of lath-work. These beacons can be moved about more easily than the fixed lights in case the course of the fairway changes.

The lights on the mooring-posts also afford guidance. These mooring-posts carrying gas-lamps and

gas-reservoirs serve to indicate to navigators the heads of the submerged dams. They are of light construction in order that in case of collision only the mooring-posts and not the ship will be damaged. At present a very slight shock is sufficient to overturn the posts, whilst the expense incurred in repairing them is insignificant and is recoverable from the vessel responsible for the collision.

Red lights indicate the mooring-posts on the North side of the fairway, and white lights those on the South.

The illuminant for these intermittent lights is oilgas which is forced into the reservoirs fixed between the piles of the mooring-posts under a pressure of eight atmospheres. The gas is generated in a works at the Hook of Holland.

Two steam and two ordinary lifeboats are stationed at the Hook of Holland to render assistance to vessels in distress.

In behalf of persons shipwrecked through the grounding of vessels on the North Pier — which is not always accessible to lifeboats — a life-saving installation has been erected on the south side of that pier. It consists of two towers connected to each other by a steel cableway at a height of seven metres above high water, and along which an iron carriage can run. The outer tower is connected to the lighthouse on the head of the pier by a cable bridge. Along this bridge the shipwrecked persons who are able to reach the lighthouse can reach the outer tower of the lifesaving installation, enter the carriage, and so

ROYAL DUTCH PETROLEUM COMPANY

BENZINE INSTALLATION, 60 TANKS WITH A TOTAL CAPACITY OF 16 000 000 GALLONS.
DISTILLERY WITH A CAPACITY OF 75 000 GALLONS PER DAY.

reach the other tower after a journey of 130 metres along the cable. They can then descend a ladder to the landing stage at the foot of the tower which the life boats can reach at any time.

By day as well as by night the depth of water in the fairway within the mouth at the Hook of Holland is indicated by a semaphore visible from a great distance. Balls and cones give the signals by day and lanterns at night. The hoisting of a white flag with a black cross or of a blue pendant near the other signals indicates high and low water respectively.

VIII.

THE SIGNIFICATION OF THE WATERWAY FOR COMMERCE AND SHIPPING.

The New Waterway gives on the one hand access to the North Sea, from where steamship-lines run to all points of the compass, and on the other hand connection with the Central European railway system along the Rhine and its tributaries.

Imported products and minerals transshipped at Rotterdam reach their destination along these ways.

Although a small number of sea-going vessels, the so-called Rhine ships — which go up the Rhine as far as Cologne — also pass the bridges which cross the Nieuwe Maas and the Koningshaven at Rotterdam, these bridges may none the less be regarded

as the line of demarcation separating ocean and inland traffic.

Beyond these bridges are the moorings for inland shipping as well as the free anchorage for the Rhine ships, whilst below the bridges large and small docks are to be found which have been constructed at a cost of fl. 60.000.000 by the city of Rotterdam to meet the ever increasing demand for wharfage and moorage.

Shipbuilding yards and industrial enterprises which were formerly established only upstream beyond the bridges, have in recent years been located below the bridges.

On both banks shipbuilding yards have been opened, factories built, warehousing accomodation for all kinds of articles provided, storage plants for petroleum, benzine and other liquids laid down, and bunkering appliances constructed.

On the left bank, on the Island of Rozenburg, a dock has been constructed by the Government, where vessels carrying explosives may temporarily leave their dangerous cargo before proceeding to Rotterdam. Between Vlaardingen and Maassluis docks belonging to private firms have been constructed to provide accomodation for loading and discharging ships.

Opposite Vlaardingen ample opportunity is provided for bunkering sea-going vessels. At the Hook of Holland a quay for ships of great draught has been built alongside the right bank for the purpose of landing passengers and for discharging cargo arriving by the boats of the Holland America Line. At

PETROLEUM ESTABLISHMENT "CHARLOIS".

WHARF OF MESSRS. PAKHUISMEESTEREN, ROTTERDAM. HANDLING AND STORING OF PETROLEUM, GASOLINE, SPIRIT OF TURPENTINE, ROSIN, TAR, PITCH, ETC.

the Hook of Holland is also the quay for the boats plying daily between that place and Harwich.

Amongst the various commercial establishments at the Hook of Holland the export slaughter-houses are the most important.

Several plans for the construction of docks wharves, drydocks, etc., by the authorities of the towns situated along the Waterway, as well as by private firms, are now being put into execution or are being prepared.

The specially favourable situation of the numerous plots of land along the Waterway which have been created by raising the level of low-lying land with dredgings from the river, provide location for commercial establishments which are being opened along the Waterway and especially on the right bank which is but a short distance from the railway connecting Rotterdam with the Hook of Holland, so that these establishments can easily secure railway connection.

The following table giving the lowest and the highest mark at low water as signalled by the Admiralty at the Hook of Holland, shows the constant increase of same.

VIEW OF THE KONINGSHAVEN AT ROTTERDAM.

During:	Lowest mark at Low-water during the year.	Highest mark at Low-water during the year.	Remarks.
1872	—	—	In the line of the leadinglights of the Noordgat at the entrance.
1873	21	26	
1874	26	32	
1875	33	39	
1876	30	38	
1877	30	37	
1878	25	39	
1879	34	44	
1880	26	32	
1881	30	31	Depth on the north side
1882	30	33	Depth in the line of the leading-lights.
1882	37	40	In Westgat with channel 150 M. wide.
1883	37	47	In Westgat with channel 150 M. wide.
1884	40	53	
1885	55	57	In Westgat with channel 150 M. wide.
1886	55	64	In Westgat with channel 150 M. wide.
1887	59	65	In the channel 100 M. wide.
1888	58	62	
1889	62	70	
1890	67	73	
1891	64	76	
1892	62	77	
1893	76	81	
1894	82	85	In the channel 110 M. wide.
1895	77	82	
1896	80	84	
1897	77	82	

During:	Lowest mark at Low-water during the year.	Highest mark at Low-water during the year.	Remarks.
1898	81	85	In the channel 110 M. wide.
1899	76	86	
1900	84	87	
1901	84	87	
1902	80	87	
1903	80	87	
1904	85	88	
1905	85	88	
1906	83	88	
1907	87	87	In the channel 120 M. wide.
1908	88	89	
1909	89	90	
1910	90	90	
1911	90	90	
1912	90	92	
1913	90	92	
1914	92	92	

OFFICE AND LANDING-PLACE AT ROTTERDAM PRINS HENDRIKKADE.

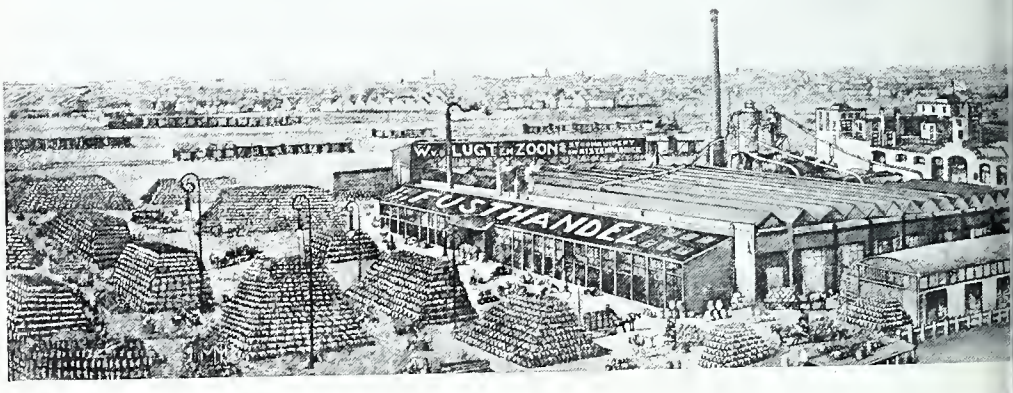
The following table shows the depth in the fairway between Rotterdam and the sea at the shallowest places at low water:

1879	32	decimetres	1897	61	decimetres
1880	32	„	1898	61	„
1881	32	„	1899	59	„
1882	33	„	1900	64	„
1883	42	„	1901	65	„
1884	44	„	1902	66	„
1885	49	„	1903	62	„
1886	52	„	1904	67	„
1887	56	„	1905	70	„
1888	54	„	1906	66	„
1889	57	„	1907	65	„
1890	58	„	1908	75	„
1891	56	„	1909	75	„
1892	56	„	1910	78	„
1893	60	„	1911	80	„
1894	62	„	1912	82	„
1895	64	„	1913	83	„
1896	64	„	1914	83	„

The increase of the depth of the fairway has been accompanied by a proportionate increase in the number of sea-going and inland vessels navigating the Waterway as appears from the following figures.

"FYENOORD", SHIPBUILDING AND ENGINEERIN

W. VAN DER LUGT AND SONS STEA



MANUFACTORY OF WOOD

ANY. (ESTABLISHED 1823) ROTTERDAM. 2

CERAGE AND CASE FACTORY.

NG ARTICLES ROTTERDAM. 2

SHIPPING.

Years.	Steamers and sailing vessels entering and leaving the Waterway not including fishing vessels		Number of vessels with a draft in decimetres of:						
	Number.	Gross Capacity in cubic metres.	55—64	65—74	75—79	80—84	85—89	90 and over.	total with a draft of 55 and over.
1872	416	—	—	—	—	—	—	—	—
1875	7172	6 009 465	—	—	—	—	—	—	—
1880	7008	8 382 969	—	—	—	—	—	—	—
1885	7915	12 366 227	500	32	—	—	—	—	532
1890	9637	17 078 007	848	322	—	—	—	—	1170
1895	10922	24 171 138	1191	549	19	—	—	—	1759
1900	15202	36 348 613	1692	923	66	7	—	—	2688
1905	17937	49 056 539	2402	1321	188	32	13	—	3956
1906	18818	53 396 417	2387	1483	219	37	14	—	4140
1907	20315	59 534 880	2589	1593	243	59	15	—	4499
1908	18129	53 300 787	2333	1374	211	47	8	1	3974
1909	19839	57 833 340	2573	1574	261	71	17	1	4497
1910	20799	64 421 774	3029	1774	296	72	24	1	5196
1911	20927	66 764 305	3182	1855	309	131	41	2	5520
1912	23006	75 457 390	3649	2014	377	146	57	11	6254
1913	22645	77 953 695	3520	2172	483	172	67	25	6439
1914 *)	16126	56 242 417	2427	1411	283	147	52	21	4341

*) War-year.

Thanks to the progress made in the deepening of the fairway the draught not only of incoming but also of outgoing vessels was enabled to be increased.

Whereas vessels drawing 75 decimetres and upwards were very rarely seen in the Waterway up to 1894, 51 navigated the channel in 1898, 267 in 1908, and 747 in 1913.

In 1898 only 6 vessels with a draught of 80 decimetres, navigated the Waterway, in 1908 56; in 1913 the number had increased to 264, and in 1914 (war-year) the number was 220.

In 1913 the Waterway was navigated by

9	vessels	with	a	draught	of	90	decimetres,	
8	"	"	"	"	"	91	"	,
3	"	"	"	"	"	92	"	,
4	"	"	"	"	"	93	"	, and
1	vessel	"	"	"	"	94	"	,

of which the majority were engaged in the regular trade to North America.*)

The largest steamer at present navigating the Waterway is the Holland America Line's "ROTTERDAM" which is 203 metres in length, 23.4 metres in breadth and has a maximum draught of 10.06 metres.

Next year a still larger steamer the "Statendam" owned by the same company will be running. This ship was launched in July last, its dimensions being: length 233.8 M., breadth 26.2 M., maximum draught 9.75 M.

*) In 1914 the Waterway was navigated by a steamer with a draught of 95 decimetres

In the last thirty years inland shipping and especially Rhine shipping has made great progress in consequence of the increasing volume of the transit trade as is shown by the following table.

INLAND SHIPPING AND RHINE SHIPPING AT ROTTERDAM.

Year.	Number of ships.	Capacity in cubic Metres.
1880	63.542	4.008.188
1885	73.615	5.110.516
1890	89.969	6.916.442
1895	98.650	9.955.615
1900	115.845	15.044.049
1905	132.230	20.801.979
1906	139.518	22.513.537
1907	143.214	24.643.711
1908	140.317	23.610.322
1909	143.231	24.945.969
1910	128.569	26.427.207
1911	135.187	27.870 834
1912	136.887	29.187.791
1913	140 469	30.417.170

These figures indicate that the average capacity of vessels engaged in the inland trade is constantly increasing; this is especially the case with Rhine lighters.

At the moment, for instance, a so-called Rhine-

lighter with a length of 100 metres, breadth upwards of 12 metres, and a capacity of 3000 cub. metres is quite common.

IX.

CONCLUSION.

Although from the foregoing statements it appears that as a result of the success obtained vessels drawing 9.50 metres of water can navigate the Waterway, yet the fact must not be ignored that in the immediate future the Waterway will have to be prepared to cope with greater demands if Rotterdam is to continue to occupy its position of honour amongst the greatest commercial ports of Europe.

At present the draught of ships is, and in the future will still more be, dominated by the depth of the great waterways where steamship lines from all parts of the earth meet together, and by the depths of the entrances to the large commercial ports.

The Suez Canal occupies a foremost place amongst those waterways. Seeing that this canal is at no point less than 10 metres in depth and that at the end of this year it is proposed to increase the maximum draught to 9.14 metres; seeing that the Panama Canal is about to be opened and can accomodate vessels of still greater dimensions; seeing further that shipowners are constantly having ships of deeper draught built, it becomes evident that it is absolu-

MESSRS. P. SMIT JR. ENGINEERS AND SHIPBUILDERS ROTTERDAM

SHIPBUILDING YARD, ENGINE AND BOILER WORKS. SLIPWAY, FOUNDRY, FORGE.

tely necessary to improve the entrances of great ports used by ocean-going steamers in such a manner that these leviathans may find accomodation.

The Netherlands Government has also looked into the future and had plans drawn up accordingly.

In this connection it has been taken for granted that the New Waterway must be navigable for vessels with a draught of 12.20 metres, but from a technical standpoint it is regarded as desirable not to carry out the required deepening of the channel all at once, but gradually. The object in the first place will be to secure a continuous fairway with a depth of at least 10 metres at low water or 11.50 metres at high water, in order that vessels drawing 11 metres may be able to reach Rotterdam.

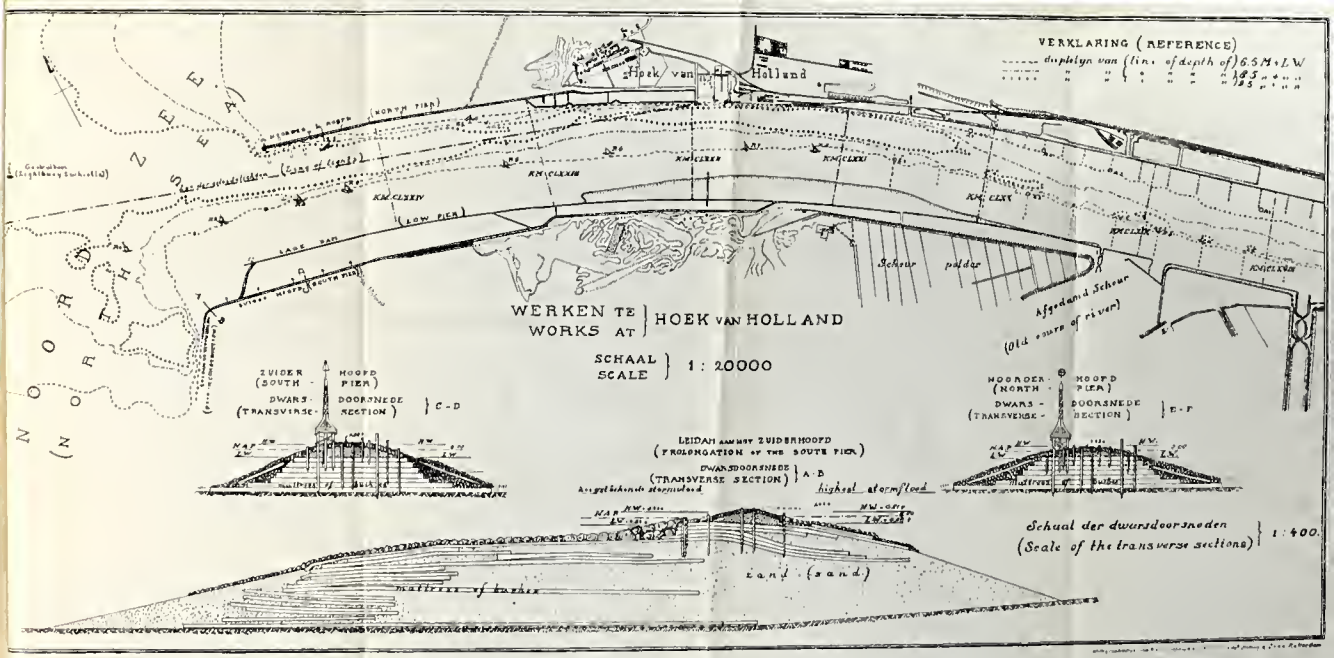
A. T. DE GROOT.

Waterstaat Engineer.

Rotterdam, December 1914.

NOORD ZEE
SCHIERMONNIKOOG
DELFLAND
SCHIELAND
LOPIKER
WAARD
KRIMPENER
WAARD
VIJF
HEEREN
LANDEN
GOUDA
SCHIEDAM
ROTTERDAM
BRIELLE
VOORNE
IJSSELMONDE
PUTTEN
DEIJERLAND
HOEKSCHE WAARD
OVERFLAKKEE
SCHOUWEN
DUIVELAND
HOLLANDSCH
DIEP
GORINCHEM
LAND
VAN
ALTENA
1 : 500000

WATERWEG VAN ROTTERDAM NAAR ZEE.
WATERWAY FROM ROTTERDAM TO THE SEA.
SCHAAL 1:40000.
NOORD
Gem^te Rotterdam
NIEUWLANDSCHE POLDER
Gem^te Rotterdam
Gem^te Naaldwijk
Gem^te Maasland
Gem^te Vlaardingerambacht
Gem^te Schiedam
SCHIEDAM
VLAARDINGEN
MAASSLUIS
Gem^te Maasland
Gem^te Rozenburg
ROZENBURG
Gem^te Rotterdam
Gem^te Rotterdam
IJSSELMONDE
Gem^te Pernis
Gem^te Rozenburg
Getijlijn te Hoek van Holland op 5 Juli 1914.
Tide-line at Hoek van Holland on the 5th July 1914
NAP
Lijnen van Hoog- en Laagwater
Lines of High- and Low-water
HW
LW
NAP


VERKLARING (REFERENCE)
dwarslijn van (line of depth of) 6.5 M + L.W.
" " " " " 8.5 " " "
" " " " " 10.5 " " "
Hoek van Holland
(NORTH PIER)
(LOW PIER)
(SOUTH PIER)
LAGE WAL
NOORD ZEE
(NORTH SEA)
KM. CLXXIV
KM. CLXXIII
KM. CLXXII
KM. CLXXI
KM. CLXX
KM. CLXIX
KM. CLXVIII
Scheur
polder
Afgestand Scheur
(Old course of river)
WERKEN TE
WORKS AT
HOEK VAN HOLLAND
SCHAAL
SCALE
1 : 20000
ZUIDER (SOUTH - HOOFD PIER)
DWARS - DOORSNEDE
(TRANSVERSE - SECTION)
C - D
NOORDER (NORTH - HOOFD PIER)
DWARS - DOORSNEDE
(TRANSVERSE - SECTION)
E - F
LEIDAM AANHET ZUIDERHOOFD
(PROLONGATION OF THE SOUTH PIER)
DWARSDOORSNEDE
(TRANSVERSE SECTION)
A - B
hoogste stormvloed
highest stormflood
NAP
L.W.
M.W.
mattress of bundles
sand (sand)
Schaal der dwarsdoorsneden
(Scale of the transverse sections)
1 : 400.